PERIODIC AUTOREGRESSIVE MOVING AVERAGE MODELS FOR THE ANALYSIS OF STREAMFLOW

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ABSTRACT

Streamflow values show definite seasonal patterns in their month-to-month correlation structure. The structure also seems to vary as a function of the type of stream (coastal versus mountain or humid versus arid region). The standard autoregressive moving average (ARMA) time series model is incapable of reproducing this correlation structure. While the seasonal ARMA model (in which adjustments are made for the seasonal nature of the flow but the parameters of the ARMA model are constant over the year) does provide a better fit, it too is insufficient. An ARMA model could be fitted to each month or season of the year, but the number of resulting parameters would be large, and solving the equations for them would be difficult.

A periodic ARMA time series model is one in which an ARMA model is fitted to each month or season but the parameters of the model are constrained to be periodic according to a Fourier series. This constraint greatly reduces the number of parameters but still leaves the flexibility for matching the seasonally varying correlograms. Fitting the model to time series for several stations over the western part of the United States has shown that only a few (generally two) harmonics of the Fourier series are needed to provide a good reproduction of the correlogram. The ability to describe a seasonally varying correlogram with only a few such parameters may be a first step in differentiating types of streams according to their flow regime and, possibly, modeling the affects of changes in climate on future streamflows.